

RADIATION PROTECTION IN DENTISTRY



NATIONAL COUNCIL ON RADIATION
PROTECTION AND MEASUREMENTS
REPORT No. 145

- Radiology is an essential component of dental diagnosis. Ionizing radiation, if delivered in sufficient doses, may produce biological damage.
- Radiation in doses required for dentistry may not present any risks, however these small doses are not necessarily risk free.



The benefit to the patient from dental radiographic examination will outweigh potential risk from radiation exposure provided that:

- Radiographic exam is clinically indicated and justified
- Techniques used are optimized to produce high-quality images
- Principles are followed to minimize exposure to the patient, staff, and the public



PURPOSE OF NCRP REPORT No. 145

- Present methods and procedure for radiation protection in the dental office



GOALS

- Eliminate unnecessary radiation exposure to the patient
- Exposures to the office staff and the public are within regulatory limits and meet ALARA (As Low As Reasonably Achievable)



Biological Effective of Ionizing Radiation fall in two classes

- Deterministic – receiving a high dose all at once exceeding some threshold (i.e. radiation sickness). Severity is proportional to dose.
- Stochastic – all-or-nothing effects. Severity is not dose dependent. Probability of occurrence is proportional to dose (no threshold)
- So the basic goal of radiation protection is to prevent exposures that cause deterministic effects and reduce the potential for stochastic effects



Occupational effective dose

- Shall not exceed 50 mSv in any one year. Numerical value of the individual worker's lifetime occupational effective dose is 10 mSv times the age value

Example – at age 18 start receiving a occupational dose of 50 mSv/year. This equals 200 mSv at age 22. Lifetime cumulative dose at 22 is 220 mSv. Therefore the individual should revert back to 10 mSv/year to maintain the lifetime cumulative dose.



Other occupational equivalent doses

- 0.5 mSv in a month to the embryo or fetus for pregnant individuals (once pregnancy is known).
- Mean nonoccupational effective dose to frequently or continuously exposed public (excluding doses from natural background or medical care) 1mSv/year
- Infrequently exposed public 5mSv/year



Dental Facility

- Design, x-ray equipment performance and operating procedures shall be such that no individual exposure exceeds the recommended dose limits.
- Facility design, x-ray equipment performance and operating procedures should be established as low as reasonably achievable, economic and social factors being taken into account.
- The ALARA principle.



The Dentist

Shall establish a radiation program to include:

- Instructing staff in radiation protection
- Implementing radiation surveys, recording results and corrective actions
- Establishing the monitoring of personnel
- Ensuring all protection features are functioning and warning signs are posted
- Implementing and monitoring the ALARA principle
- Implementing and documenting quality-assurance procedures



The Dentist

- All radiographic examinations shall be preformed only on direction of the dentist. Procedures shall be prescribed only after a physical exam and clinical history of the patient.
- X-rays shall only be preformed by the dentist or legally qualified and credentialed personnel.

Personnel should be provided the opportunity to attend continuing education programs



Patient Protection

- For each new or referred patient, the dentist shall make a good faith attempt to obtain recent, pertinent radiographs from the patient's previous dentist.
- Radiographic examinations shall be preformed only when indicated by patient history, physical examination by the dentist, or laboratory findings



Patient Protection

- Administrative use of radiation to provide information not related to health of the patient shall not be permitted. Students shall not be permitted to perform radiographic exposures of patients, other students, or volunteers solely for purposes of their education or licensure



X-ray Machines

- Purchase and operation of dental x-ray equipment shall ensure that the equipment meets or exceeds all applicable governmental regulations. Design specification must also be met.
- Portable x-ray machines shall not be used if fixed machines are available and patient's conditions allow their use.



Examinations And Procedures

- The operating potential of dental x-ray machines shall not be less than 50 kVp and should not be less than 60 kVp.

The operating potential shall not be more than 100 kVp and should not be more than 80 kVp

- Position-indicating devices shall be open-ended devices with provisions for attenuation of scattered radiation arising from the collimator or filter.



Examinations And Procedures

- Source-to-image receptor distance for intraoral radiography shall not be less than 20 cm and should not be less than 40 cm
- Rectangular collimation of the x-ray beam shall be routinely used for periapical radiography. Each dimension of the beam, measured in the plane of the image receptor should not exceed the dimension of the image receptor by more than two percent of the source-to-image receptor distance.



Examinations And Procedures

- Image receptors of speeds slower than ANSI Speed Group E films shall not be used for intraoral radiography.
- Occupationally-exposed personnel shall not restrain uncooperative patients or hold the image receptor in place during an x-ray exposure. Members of the public who restrain or hold image receptors shall be provided with shielding.



Examinations And Procedures

- The fastest imaging system consistent with the imaging task shall be used for all extraoral dental radiographic projections.
- Panoramic x-ray machines shall be capable of operating at exposure appropriate for high-speed (400 or greater) rare-earth screen-film systems or digital image receptors of equivalent or greater speed.



Examinations And Procedures

- Only the fastest screen-film system compatible with imaging requirements shall be used for the cephalometric image. Filters for imaging the soft tissues of the facial profile together with the facial skeleton shall be placed at the x-ray source rather than at the image receptor.
- The x-ray beam for the cephalometric radiography shall be collimated to the area of clinical interest.

Fluoroscopy shall not be used for static imaging in dental radiography



Examinations And Procedures

- Dental radiographic films shall be developed according to the film manufacturer's instructions, using the time and temperature method and recommended chemistry. Sight developing shall not be used.
- Radiographic techniques for digital imaging shall be adjusted for the minimum patient dose required to produce a signal-to-noise ratio sufficient to provide image quality to meet the purpose of the examination



Examinations And Procedures

- Thyroid shielding shall be provided for children, and should be provided for adults, when it will not interfere with the examination.



Shielding

- If conventional building structures do not provide adequate shielding, the addition of lead, gypsum, steel concrete or other suitable material shall be used.
- Shielding design by a qualified expert shall be provided for all new or remodeled facilities.
- Adequacy of shielding shall be determined by calculation and checked by survey measurements.



Shielding

- Shielding design for new offices shall provide protective barriers for the operator. The barriers shall be constructed so operators can maintain visual contact and communication with the patient.
- In the absence of a barrier in an existing facility, the operator shall remain at least 2 meters from the tube head during exposure.



DOSIMETRY

- Personal dosimeters for external exposure measurement should be considered for workers who are likely to receive an annual dose effective dose in excess of 1 mSv.
- Personal dosimeters shall be provided for known pregnant occupationally-exposed personnel.



DOSIMETERY

- An other patient in the room during a expose shall be treated as a member of the public.
- When portable x-ray machines are used all individuals in the area shall be protected as members of the public.
- New dental facilities shall be designed so that individual members of the public will not receive an effective dose in excess of 1 mSv annually.



Quality Assurance

- Written protocols for periodic quality assurance shall be developed and implemented for each x-ray machine, image receptor system, and processor or darkroom.
- New and existing facilities not previously surveyed shall have a survey conducted by, or under the supervision of, a qualified expert.
- Resurveys shall be preformed at intervals not exceeding 4 years.



Quality Assurance

- Darkroom chemistry and each film processor used shall be evaluated daily for performance and overall quality of the resulting films.
- Film used shall be evaluated for fog and artifacts monthly and each time a new box or batch of film is opened.



Quality Assurance

- Screen-film cassettes shall be visually evaluated after any accident and contact test should be performed every 6 months. Defective items shall be repaired or replaced promptly
- Darkrooms and daylight loaders shall be evaluated for integrity at installation, monthly and following changes of room lighting, safelight lamp or filter



Quality Assurance

- Lead aprons and thyroid collars shall be visually inspected for defects monthly, or more frequently if they are damaged.
- Fluoroscopic examination for hidden defects should be performed annually.
- A log of all quality-assurance procedures shall be maintained and shall contain date, procedure, results and any corrective actions.



Training

- The dentist or designated individual shall provide training in radiation protection for all dental personnel sufficient to ensure that they understand and comply with all recommendations in NCRP report No 145
- Opportunities should be provided for auxiliary personnel to attend appropriate continuing education courses.
- Dentist should regularly attend continuing ed. Courses in all aspects of dental radiology, including radiation protection.



Equipment

- X-ray machines shall comply with all applicable laws, standards and regulations.
- Older equipment shall be brought into compliance with these requirements and recommendations or be replaced.
- Dental x-ray machines shall provided a range of exposures suitable for use with the fastest image receptors appropriate for those clinical procedures for which it was designed.



Equipment

- The tube head shall achieve a stable position, free of drift and oscillation, within 1 second after release at the desired position. Drift shall not be more than .5 cm



Equipment

- Equipment used with intraoral image receptors shall be capable of providing rectangular collimation to approximate the dimensions of the image receptor
- The linear dimensions of the beam in each axis should not exceed those of the receptor by more than 2 percent of the source-to-image receptor distance.



Equipment

- Rotational panoramic tomography
 - Shall be collimated so vertical dimension is no greater than the area of clinical interest
 - Shall not be larger than the slit in the image-receptor plus a 2% tolerance of the source-to-image distance

Cephalometric radiography

- Provide for asymmetric collimation of the beam
- Use a wedge to reduce exposure to facial profile



Equipment

- With multiple x-ray tube installations shall not be possible to energize more than one tube at a time
- The patient shall be visible to the operator
- Control panel shall indicate which tube is energized



Qualified Expert

- Guidance for design of a facility
- Establishing protection policies and procedures.
- Surveys of equipment performance
- Operation changes to improve protection

Dentist is responsible for corrective action

